

Wearable Exoskeleton Gait Training For Pediatric Peripheral Polyneuropathy : A Case report

Byeong-Hun Oh MD¹, Da-Sol Kim MD, PhD^{1,2}, Gi-Wook Kim, MD, PhD^{1,2}, Yu-Hui Won, MD, PhD^{1,2}, Myoung-Hwan Ko, MD PhD^{1,2}, Jeong-Hwan Seo, MD, PhD^{1,2}, Sung-Hee Park, MD, PhD^{1,2},

¹Department of Physical Medicine & Rehabilitation, Jeonbuk National University Medical School, Jeonju, Korea

²Research Institute of Clinical Medicine, Biomedical Research Institute of Jeonbuk National University Hospital

Introduction

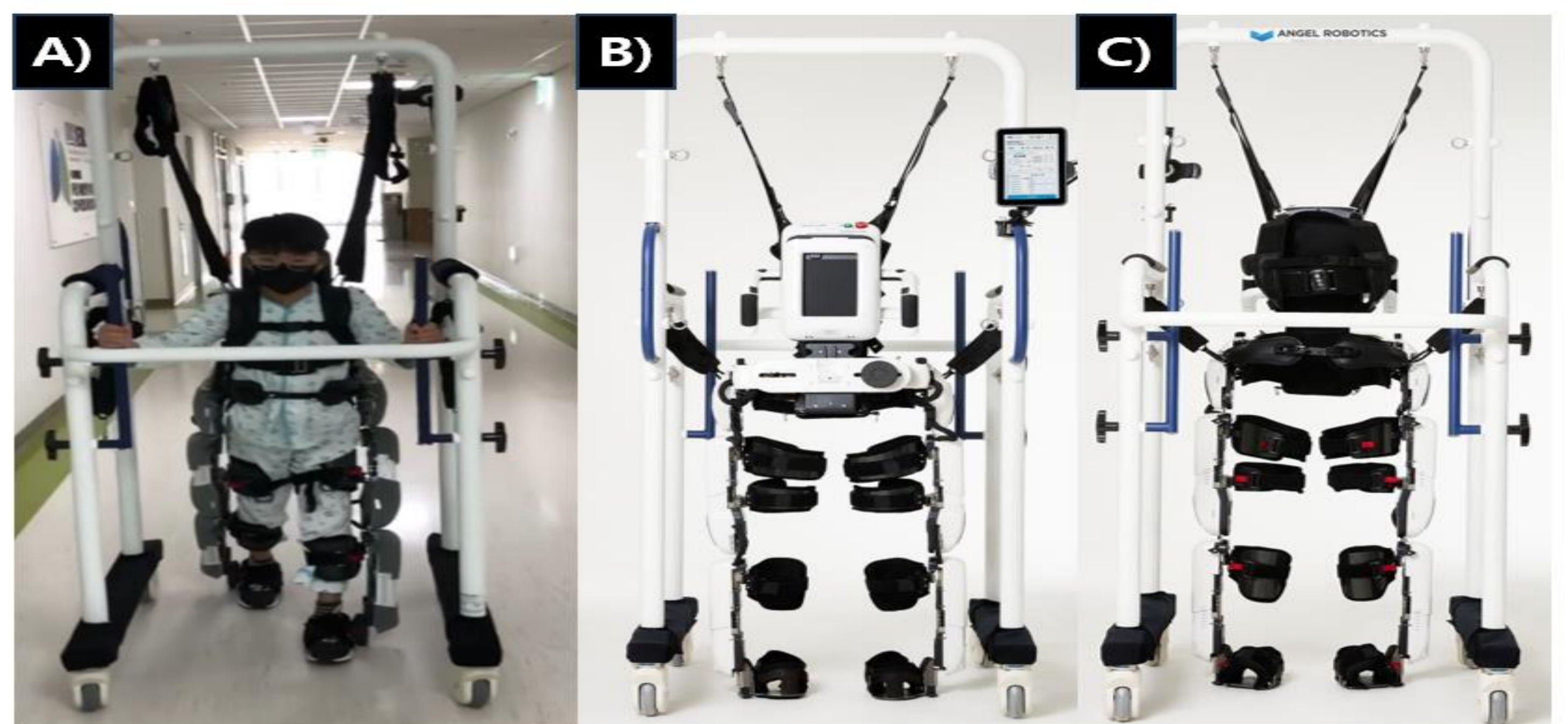
- Wearable robotic exoskeleton-assisted gait training has been used mainly in pediatric central nervous system disorders.
- Evidence for acute pediatric peripheral nervous system disease remains limited.
- We report functional, kinematic, and cardiopulmonary changes after overground exoskeleton gait training in a child with acute peripheral polyneuropathy.

Methods

- **Patient:** A 10-year-old boy with lower-extremity weakness due to suspected Guillain-Barré syndrome / peripheral polyneuropathy.
- **Intervention:** 10 sessions over 2 weeks of powered overground robotic exoskeleton training (20 minutes of walking within a 30-minute session) with an overhead safety harness.
- **Outcomes:** 10-meter walk test (10MWT), 6-minute walk test (6MWT), Berg Balance Scale (BBS), Timed Up and Go (TUG), Functional Reach Test / modified Functional Reach Test (FRT/mFRT), device-derived cadence and hip/knee kinematics, and cardiopulmonary exercise testing (CPET).

Figure 1. Overground wearable exoskeleton-assisted gait training using the Angel Legs system

A pediatric participant performed overground walking while wearing the Angel Legs lower-limb exoskeleton within a mobile support frame and overhead safety harness.



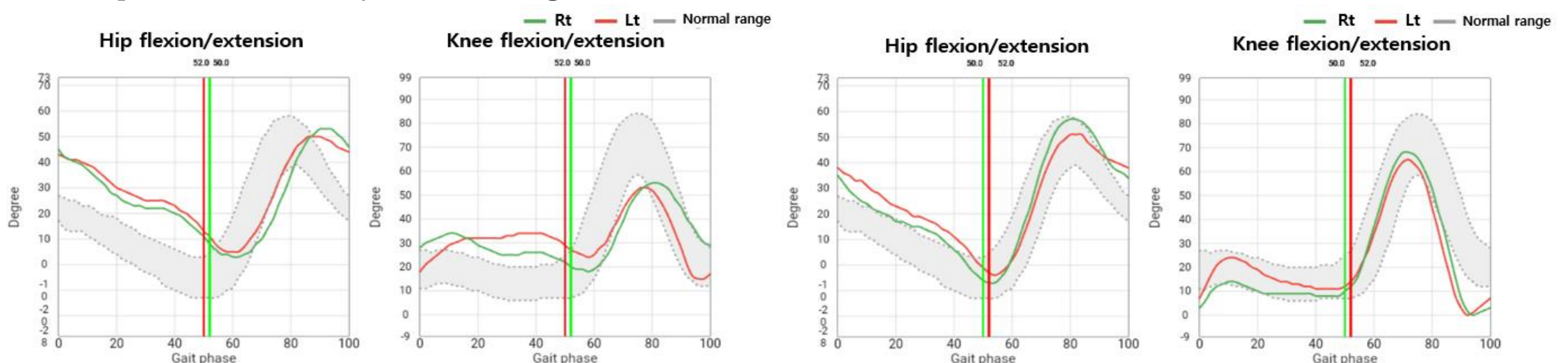
Results

Table 1. Changes in functional mobility, balance, and cardiopulmonary exercise outcomes before and after intervention

	Pre-treatment	Post-treatment
10MWT		
(Comfortable speed, m/s)	0.65	1.24
10MWT		
(Maximum speed, m/s)	0.81	1.91
6MWT		
(Total distance, m)	333	526
6MWT		
(Average speed, m/s)	1.11	1.75
BBS	37	50
TUG	10.5	7.8
Anterior reach (sitting, cm)	32	49.5
Anterior reach (standing, cm)	22	42
VO₂ max (L/min)	0.65	1.24
METS (ml/kg/min)	0.81	1.91
Maximal exercise time (sec)	333	526

10MWT: 10-meter walk test; 6MWT: 6-minute walk test; m: meter; m/s: meter/second, BBS: Berg balance scale; TUG: timed up and go; FRT: functional reach test; METS: metabolic equivalents, VO₂ max : maximum rate of oxygen consumption

Figure 1. Hip and knee flexion/extension angles before and after intervention



The patient's hip and knee kinematics were outside the normative band at baseline and aligned more closely with the normal range after training.

- Gait speed improved on the 10MWT at comfortable speed (0.65→1.24 m/s) and maximum speed (0.81→1.91 m/s), and 6MWT distance increased (333→526 m; average speed 1.11→1.75 m/s).
- Balance improved (BBS 37→50; TUG 10.5→7.8 s), with increases across FRT/mFRT measures.
- Cadence increased (left/right 68.6/69.6→79.8/78.1 steps/min), hip and knee angle trajectories approached normative ranges
- CPET indices increased (VO₂max 0.65→1.24 L/min; METs 0.81→1.91; maximal exercise time 333→526 s).

Conclusion

- A short, intensive course of overground wearable exoskeleton gait training was associated with marked improvements in gait performance, balance, and cardiopulmonary fitness in this pediatric patient with acute peripheral polyneuropathy.